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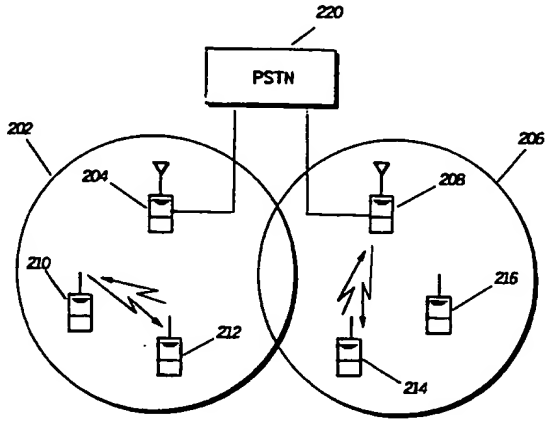
(54) Title: PORTABLE TO PORTABLE COMMUNICATIONS IN A CORDLESS TELEPHONE SYSTEM




(57) Abstract

A communication system (200) includes at least one base station (204 and 208) and a plurality of portable communication devices (210, 212, 214 and 216). The present invention provides for one of the portable communication devices (210, 212, 214 or 216) to emulate at least one of the base station's communication protocol parameters in order for the portable communication device to communicate directly with another of the portable communication devices.

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# PORTABLE TO PORTABLE COMMUNICATIONS IN A CORDLESS TELEPHONE SYSTEM

## Technical Field

This invention relates generally to communication systems and more specifically to the field of cordless telephone systems.

## Background

Portable telephone systems, such as second-generation digital cordless telephone (CT2) systems, typically include multiple call point stations each providing multiple RF channels. These call point stations also being referred to as telepoints or cordless fixed parts (CFPs). CFPs allow persons using portable telephone handsets (also known as cordless portable parts, CPPs), to access the public switched telephone network (PSTN). Access to the PSTN can occur when a CPP gets in range of a telepoint (CFP) and after the CPP (handset) has established a synchronous link with the CFP (base station).

In a CT2 system, a handset initiating a call to a base station asynchronously transmits on one available channel of the handset's transceiver, which corresponds to a radio frequency (RF) channel in the base station (each base station being capable of supporting up to 40 channels).

In a typical CT2 system, the communication protocol standard includes four main burst structures, called multiplex 3 (MUX 3), multiplex 2 (MUX 2) and multiplex 1 (MUX 1) which is further sub-divided into either multiplex 1.4 or 1.2 (MUX 1.4 or MUX 1.2). MUX 3 is utilized mainly for communication link initiation (link establishment and re-establishment) from a CPP to a CFP. MUX 2 is used primarily for communication link establishment and for link initiation from the base station(CFP). The MUX 1 burst structures (MUX 1.2 and MUX 1.4) are used primarily for voice/data communications, signaling information, and control messages from the CPP (portable) and CFP (base).

For a better understanding of the overall CT2 system communication protocol, one is referred to a publication entitled, "Common air interface specification to be used for the interworking between cordless telephone apparatus in the frequency band 864.1 MHz to 868.1 MHz, including public access services", Version 1.1, dated 30th June 1991, which is published by the European Telecommunications Standards Institute and is hereby incorporated by reference.

In present CT2 systems, all communications occur between the CPPs and CFPs, with typically the CPPs initiating the calls to the CFPs, although CFPs can also initiate calls to individual CPPs. Using the CT2 protocol standard (CAI), a cordless handset (CPP) initiating a call, asynchronously transmits using MUX 3 on an available radio frequency channel to the base (CFP), while the base station scans in MUX 3 waiting for a poll by one of the CPPs in the system.

In FIG. 1, a table showing the typical handshake sequences between a cordless portable part (CPP) and the telepoint base station (CFP) are shown. The matrix 100 shows the link setup direction, the message direction, MUX mode, and the content of the link identification code (LID) for each handshake sequence. The LID code is used for the following:

i). End point identification for CPP (handset) call setup;

ii). Link reference for associating CPP (handset) and CFP (base) calls during handshake exchanges and link re-establishments; and for

iii). Base identifier (BID), which is the ringing address to which one or more CPP's will respond to.

Row 102 shows a basic sequence on how a handset (CPP) establishes communications with a telepoint (CFP), row 104 shows how a telepoint station establishes communications with a handset, and row 106 shows how a communication link is re-established in case the link is disrupted during an ongoing communication session. Looking for example at row 102, the sequence of events which occur in order to establish a communication link between a particular handset (CPP) and base station (CFP), is shown. The requesting handset (CPP) transmits in MUX 3 a message including the identification number of the handset (end point ID). This is followed by the base station transmitting in MUX 2 a message with the LID having the communication link reference identification number which informs the handset that the link has been granted.

Once the communication link establishment has occurred between the two units, the units go to the MUX 2 protocol where the CFP transmits a supervisory message and acknowledgment. The capabilities of both the CPP and CFP are determined, and authorization to use the system is determined by the CFP. The two units then move on to the MUX 1 protocol by a request from the CFP and an acknowledgment by the CPP. Once in MUX 1, dial tone is sent out by the CFP, the CPP then dials the telephone number he wishes to access. Finally, this is followed by a voice communication link being established between the CPP and the party at the dialed number telephone number. The voice messages are either transmitted using MUX 1.2 or MUX 1.4 format depending on the specific system 100 being utilized.

As mentioned previously, in present CT2 systems CPPs are only capable of communicating with CFPs, although as also mentioned before, either device can initiate a call to the other. As CT2 systems become more widely used, a need thus exists for a way of allowing for CPPs to communicate directly with other CPPs without having to go through a CFP. It would also be desirable to be able to achieve this goal while still operating under the CT2 communication protocol standard. This providing for added capabilities and benefits to CT2 handset users.

## Brief Description of the Drawings

FIG. 1 shows a matrix of the prior art handshake sequence between the cordless telephone device (CPP) and the telepoint base station (CFP).

FIG. 2 shows a diagram of a typical CT2 system in accordance with the present invention.

FIG. 3 is a diagram showing the CPP to CPP registration process in accordance with the present invention.

FIG. 4 shows a diagram of a CPP to CPP link establishment in accordance with the present invention.

FIG. 5 is a block diagram of a cordless telephone in accordance with the present invention.

## Detailed Description of the Preferred Embodiment

Referring now to the drawings and in particular to FIG. 2, there is shown a communication system such as a cordless telephone system 200 in accordance with the present invention. Cordless telephone system 200

is preferably a second generation cordless telephone system, better known as a CT2 system. Cordless telephone system 200 comprises one or more base stations (CFPs) 204 and 208, and one or more handsets (CPPs) 210, 212, 214 and 216. Each of the CFPs 204 and 208 are coupled to a public switched telephone network (PSTN) 220. Once a handset gathers access to one of the RF channels provided by a particular base station, the base station sets up the communication link between the requesting handset and the PSTN 210, thereby allowing a handset user to make a standard telephone call to a land-line party. In system 200, base station 204 is shown to have a typical operating range shown by communication coverage area 202, while base station 208 has a coverage area 206.

Upon a handset coming in range of a base station coverage area 202 or 206, the handset can then attempt to gain access to one of the base stations communication channels. Handsets are typical very low power portable communication units having a maximum output power rating in the order of 10 milli-watts (mW). Each base station or telepoint 204 and 208 can support up to a maximum of 40 communication channels. Upon requesting access to a base station, the handset will scan the base station's RF channels in order to get an available channel (e.g., a channel which is not busy). At which point the handset transmits a link request in MUX 3 which the base station can grant using a MUX 2 return transmission. This is followed by a MUX 2 handshake between the two units and a handset ID check, in order to establish the identification of the particular handset that is originating the call. The handset ID is used for both billing purposes and to ensure that only authorized units are using the system.

In order to establish a handset to handset (CPP to CPP) communication link according to the present invention, the calling handset emulates a base station MUX 2 poll message using a BID (base identification number) in the LID field and the called handset PID (product identification number) in the HIC (handset identity code) and MIC (manufacturer identity code) fields. The poll is preferably sent out with a unique ring cadence so that the called handset user is aware that the incoming call is from a handset and not from a base station. Once the link is established, the handset initiating the call continues to emulate a base station throughout the call. This includes the handset acting as the timing master throughout the duration of the conversation. With the approach of the present invention, a handset with this feature

may establish a direct link with any CT2 Common Air interface (CAI) compatible handset (CPP). The two key functions for achieving "CPP to CPP calling" (will be referred to as "CCC") are: 1). CPP to CPP registration; and 2). CPP to CPP link establishment, both of which will be discussed in more detail below.

In FIG. 3, a registration process 300 in accordance with the present invention is shown. The registration process is a set-up process which enables a particular set of handsets to talk with each other directly. Preferably, handsets featuring handset to handset communication capability (CCC) in accordance with the present invention contain multiple registration slots and a random Base Identity Code (BID) which identifies a particular handset to other handsets registered to receive calls from it. In addition, the handset-to-handset capable handset may contain separately portioned registration slots for incoming handset calls which may be enabled and disabled at the users discretion, thereby blocking unwanted handsets from establishing access with the particular handset. Typically, since CT2 handsets are usually sold via retail outlets, the registration process as shown in FIG. 3 is required in order to enable handsets to communicate with each other directly. However, if it were known ahead of time that a particular group of handsets would needed to communicate with each other directly (CCC) the registration information (e.g., ID's of handsets which can communicate directly with a particular handset, etc.) could be programmed into each radio either at a service shop or during the manufacturing process.

The registration process is bi-directional if both handsets are capable of handset-to-hanset communications (either handset can initiate a call to the other) and unidirectional if only one handset is handset-to-handset capable (e.g., in this particular case, only the CCC capable handset would be able to initiate the call).

The CPP1 handset user initiates the registration process by selecting a new registration slot for the handset he wants to be able to communicate directly with at a later date (in this particular example it is handset CPP2). The user then presses a key sequence in his handset to enable the registration process. At this point, handset CPP1 begins MUX 3 scanning for a link identification code = "FFFF". Handset CPP2 at the same time selects a CFP (base station) registration slot for handset

CPP1. The CPP2 handset is then set to initiate a standard CFP over the air registration via the handset's keypad.

The over the air registration step is executed by the portable handset (CPP2) initiating a MUX 3 link request 302 in which the handset identity code (HIC) and the manufacturer identity code (MIC) equals the CPP2 portable identification code (PID). The link identification code (LID) for over the air registration is set equal to "FFFF". The channel marker bit pattern (CHMP) is also sent in this transmission. The receiving handset, CPP1, at the same time is scanning the available radio frequency channels in MUX 3 for a LID equal to "FFFF". Once CPP1 receives the LID, the units begin communicating in MUX 2, as shown in step 304. A link grant message 306 is then sent by CPP1, the message includes CPP2's PID and the LID, the SYNCF (synchronization word from CFP), set equal to the link reference identification number. In step 326, CPP2 sends an identification received message ("ID-OK") which includes CPP2's PID and the SYNCP (synchronization word from CPP).

CPP2 in step 308 then sends a layer two link protocol initialization command which is referred to as a Set Asynchronous Balanced Mode message ("SABM") to CPP1. This in turn is followed by CPP1 acknowledging the SABM message in step 310. Steps 308 and 310 also reset all of the state variables
( V(r) = the receive local state variable and V(s) = the send local state variable), as well as transmission of a data establishment request (DL_EST_REQ) and the indication of the Data Establishment (DL_EST_IND).

In step 308, CPP2 sends a set asynchronous Balanced mode (SABM) message to CPP1. SABM is a layer two link protocol initialization command This is followed by a SABM acknowledgment message from CPP1 to CPP2. At his point in the registration process, the communication link between CPP1 and CPP2 has been established.

In step 312, CPP2 informs CPP1 of its capabilities (TERM_CAP, terminal capabilities) including information on any activated features via element "FA". Also, in step 312 CPP2 informs CPP1 of its manufacturer's identity code (MANIC) and the manufacturers CPP model identity code (MODEL). CPP1 then informs CPP2 of its capabilities (BAS_CAP, base capabilities since CPP1 in the present invention is emulating a base station) in step 328. In step 314, CPP1

sends a message informing CPP2 of its BID and PID, and that it is capable of CPP-CPP registration. CPP2 then acknowledges receipt of the information in step 316. CPP1 then transmits an On Air Registration Acknowledgment (OARA) in step 318, and in step 320, CPP2 acknowledges receipt of the OARA. In step 318 CPP2 stores CPP1's BID allowing for incoming calls from CPP1, while in step 320 CPP1 stores CPP2's PID in the assigned registration slot. In step 322, CPP1 transmits the initialization information element (INIT), and in step 324, CPP2 acknowledges receipt of the INIT. At this point the registration of CPP1 and CPP2 is complete, thereby allowing for the two handsets to be able to communicate directly with each other, whenever they so chose.

Referring now to FIG. 4, a CPP to CPP link establishment procedure in accordance with the present invention is shown. In this procedure one handset requests to communicate with another handset directly. In this particular example, CPP1 wants to establish a communication link with CPP2. Link establishment protocol diagram 400 begins with CPP1 selecting the CPP2 registration slot previously established in the registration process. Once the CPP1 user presses the proper key entry in CPP1's keypad requesting to establish a communication link with CPP2, the CPP1 handset in step 402 transmits a poll message in MUX 2. If the poll message is successfully received by CPP2, CPP2 transmits a response to the poll which is also transmitted in MUX 2. This is followed by both units interchanging handshake ID-OK code words in steps 404 and 406.

A ring signal message is then sent in step 408. As mentioned before the ring signal message can include parameters which can inform CPP2 to ring in a distinct fashion which can inform CPP2 that the transmission is originating from a handset and not a telepoint. In steps 410 and 412 the two handsets interchange handshake ID-OK messages. This is followed by CPP1 in step 414 transmitting a message informing the ringer circuit in CPP2 to shut off. Steps 404 through 414 are repeated in order to generate a particular ring cadence (duty cycle).

The user of the CPP2 handset at this point to answer the call activates the unit's "line key" switch on the handset, which generates a link request message in step 416. Link_request is a request by CPP2 to seize a communication link. CPP1 receives the request and in step 416, transmits a link grant message. In this message, CPP1 sends a CFP acknowledgment assigning a call reference identification number.

CPP2 responds in step 418, by transmitting an identification-ok message, followed by a layer two link protocol initialization command (SABM), in step 422. CPP1 then acknowledges this command in step 424. Once the initialization command has been acknowledged, the communication link between the two handsets has been established. As before, steps 422 and 424 initialize all state variables (V(s) and V(r) to zero in order to keep the communication between the two units in synchronization.

The CPP2 unit then transmits a message informing CPP1 of its capabilities in step 426. In step 428, a ring termination message is sent to CPP2 which causes the ringing in CPP2 to turn off completely. CPP1 follows this message with a message informing CPP2 of its own capabilities in step 430. The channel control message (CC) is then transmitted in MUX 2, in step 432. CPP2 in step 434, acknowledges the channel control message in MUX 1. Another channel control message is sent out by CPP1 in step 436, this time using the MUX 1 protocol. CPP2 also acknowledges this message using the MUX 1 protocol in step 438. Once these steps are completed, the units are connected to the B channel which is a 32 kilobit per second (kbit/s) speech or data channel which is then used by the units to transmit their data or voice conversation. The units maintain this bi-directional MUX 1 transmission until one of the units decides to hang-up from the conversation. At which point a conventional hang-up routine is followed, which releases the B channel and returns the units to their stand-by states.

With the present invention, the CPP standby operation is not modified for CCC capability as the CCC poll is received in MUX 2 (step 402). Additionally, BID collisions with CFPs are avoided since CFPs monitor for only MUX 3 link requests, this eliminating outgoing CCC collisions. CPPs having CCC capability (in this particular case CPP1) using the present invention monitor for only MUX 2 polls (except for registration and link re-establishment), which eliminates CFP link request collisions. CCC link re-establishment is identical to a CPP-CFP link were the CPP that initiates the call emulates a CFP and scans for the called CPP MUX 3 link request during re-establishment.

During the present invention's link establishment procedure, as discussed above, the initiating handset (CPP1) emulates a CFP (base station) in order to establish a communication link with the second handset (CPP2). The emulation of a CFP by CPP1 includes CPP1 being the synchronization master for frame, burst and bit synchronization. In

the above example, CPP2 will synchronize its frame, burst and bit clocks to the signals received from CPP1. Also, as part of the CFP emulation by CPP1, CPP1 transmits its link establishment poll (402) in MUX 2, as compared to the standard CPP to CFP link establishment were the CPP transmits the Poll in MUX 3. This allows for other CPPs which are usually scanning in MUX 2 under the CT2 protocol to be able to receive the MUX 2 poll without modifying their standard mode of operation.

The emulation of a CFP by CPP1 as discussed above includes CPP1 emulating some the base station's communication protocol parameters as established by the CT2 common air interface standard (CAI), such as transmitting a link establishment poll in MUX2, being the timing master and other CFP emulation as shown in FIG. 3 and 4. Also, the registration process shown in FIG.3, of CPP1 scanning for a link request (step 302 ) in MUX 3, is also an emulation of a CFP by CPP1, given that CPPs normally do no not scan in MUX 3.

In FIG. 5, a simplified block diagram of a radio such as a cordless telephone 500 in accordance with the present invention is shown. Cordless telephone 500 comprises a well known RF transceiver 502 for transmitting and receiving RF communication signals via an antenna 504. CT2 handsets operate in accordance with the previously mentioned "MPT1375 Common Air Interface Specification" (CAI) which establishes a time-division multiplexed protocol having alternating one millisecond receive and transmit frames separated by guard time segments. In one multiplexing scheme each transmit/receive segment includes a B channel (64 bits) and a D channel which contains 1 or 2 bits at each end of the B channel.

A time division multiplexer (TDD) 506 is coupled to transceiver 502 for providing time-division multiplexing and receive/transmit framing of the digital signals. An ADPCM/CODEC 508 receives voice signals generated by a microphone 510 and processes them for transmission. The APCM/CODEC 508 also provides voice signals to be rendered audible via a speaker 512.

A control means such as controller 514 which is programmed in a known manner except for the modifications to obtain the present invention's capabilities, provides operational control for the cordless telephone 500. Controller 514 can be any one of a number of microprocessors or microcontrollers, the controller preferably having input/output capabilities and built-in memory. Controller 514 executes

the program which modifies the operation of cordless telephone 500 whenever telephone 500 needs to communicate directly with another cordless telephone. Controller 514 automatically modifies such communication protocol parameters as; which MUX level to use, what information packets to send, as well as other parameters which are required for telephone 500 to emulate in order for it to be able to communicate directly with other telephones, while still allowing telephone 500 to maintain compliance with the CT2 communication protocol standard (CAI).

For example, controller 514 modifies the operation of telephone 500 to transmit a link establishment message (as shown in step 402) which substantially emulates a message transmitted by a telepoint, in order for telephone 500 to be able to communicate directly with another telephone. Controller 514 also allows telephone 500 to register with another telephone by emulating a base station in the area of scanning in MUX 3 for a link request message (as shown in step 302 in FIG. 3) which is something a CT2 telephone does not perform.

A subscriber interacts with the cordless telephone via a keypad 516. Keypad 516 allows the device user to enable operational features of the telephone 500 such as CCC (handset-to-handset communications) as taught by the present invention. A display 520 provides visual interaction for the subscriber. A memory block 522 such as an electrically erasable programmable read-only memory (EEPROM), provides storage of the handset's ID number and other important information. Memory block 522 can also include a RAM portion for the temporary storage of information.

The present invention extends CT2 handset functionality to allow for communications directly between handsets without the RF link passing through a CFP, while at the same time maintaining full compliance with the CT2 Common Air Interface (CAI) protocol standard. In order to establish a CPP to CPP link, the calling CPP emulates a CFP MUX 2 poll with a BID in the LID field and the called CPP PID in the HIC and MIC fields. The poll is then sent out optionally with a unique ring cadence so that the called CPP user is aware that the incoming call is from a handset. Once the link is established, the CPP initiating the call continues to emulate a CFP throughout the call. With the approach of the present invention, a handset with this feature may establish a direct link with any CT2 CAI compatible handset.

In summary, the present invention allows for a cordless telephone handset which operates using the CT2 standard common air interface standard to be able to communicate with another handset directly without disturbing the CT2 communication standard in any fashion. The present invention also allows for a more flexible communication system since handset users can not only link up to the PSTN but to other handset users directly.

What is claimed is:

**Claims**

1. A radio for operating in a communication system having a base station and a second radio, the base station communicating with the second radio using a communication protocol having a set of predetermined parameters, the radio, comprising:

a transceiver; and

a control means coupled to the transceiver for placing the radio in a first operational state which causes the radio to emulate at least one of the base station communication protocol parameters whenever the radio attempts to communicate with the second radio directly and for placing the radio in a second operational state whenever the radio attempts to communicate with the base station.

2. A radio as defined in claim 1, wherein the control means by emulating at least one of the communication protocol parameters of the base station controls the timing synchronization of the communication messages transmitted between the radio and the second radio.

3. A radio as defined in claim 1, wherein the radio is a cordless telephone and the communication system is a cordless telephone system.

4. A radio as defined in claim 1, wherein the radio when in the first operational state sends a poll message to the second radio having unique ring cadence so that the second radio can know that it is the radio and not the base station which is attempting to communicate with the second radio.

5. A method for registering first and second radios with each other in order for them to be able to communicate directly with each other, the radios operating in a communication system having a base station that communicates with the first and second radios using a communication protocol having a predetermined set of parameters, the first and second radios having stored radio information, the registration method comprising the steps of:

at the first radio:

scanning for a link request message;

at the second radio:

transmitting a link request message to the first radio using at least one of the same communication protocol parameters the base station uses when the base station transmits a link request message to one of the radios; and

storing at the first radio, radio information from the second radio in order for the first and second radios to communicate with each other directly once the first and second radios have been registered with each other.

6. A method as defined in claim 5, wherein the base station uses a predetermined signaling multiplex in order to communicate with the first and second radios and the second radio uses the same signaling multiplex to transmit the link request message to the first radio as the base station uses when the base station transmits a link request message to one of the radios.

7. A method as defined in claim 5, wherein the first and second radios are both cordless telephones.

8. A method as defined in claim 5, further comprising the step of:

storing at the second radio, radio information from the first radio.

# FIG.1

(PRIOR ART)

| | LINK SETUP DIRECTION | MESSAGE DIRECTION | MUX MODE | LID CONTENT |
|---|---|---|---|---|
| 102 | CPP TO CFP | CPP–> CFP | MUX3 | END POINT ID |
| | | CFP–> CPP | MUX2 | LINK REFERENCE ID |
| | | BOTHWAY | MUX2<br>MUX1 | LINK REFERENCE ID |
| 104 | CFP TO CPP | CFP–> CPP | MUX2 | BASE ID (BID) |
| | | CPP–> CFP | MUX2 | BASE ID (BID) |
| | | BOTHWAY | MUX2<br>MUX1 | LINK REFERENCE ID |
| 106 | LINK RE–ESTABLISH | CPP–> CFP | MUX3 | LINK REFERENCE ID (LAST RECEIVED VALUE) |
| | | BOTHWAY | MUX2<br>MUX1 | LINK REFERENCE ID |

100

FIG.2

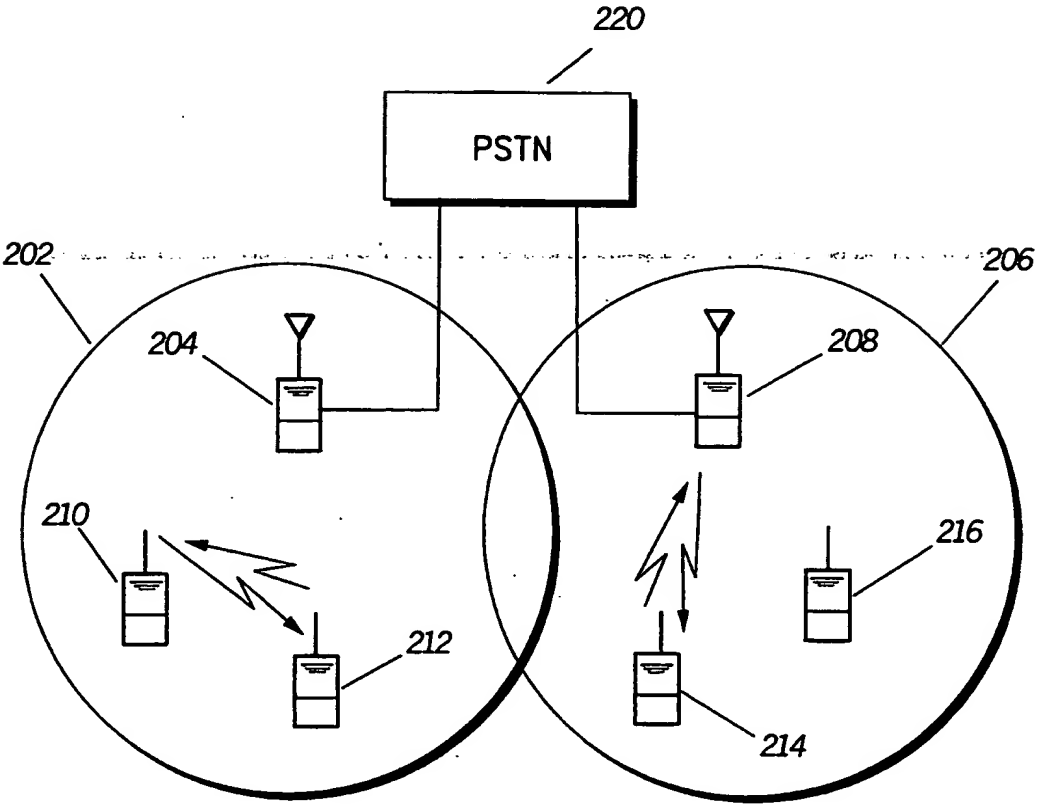


FIG.3

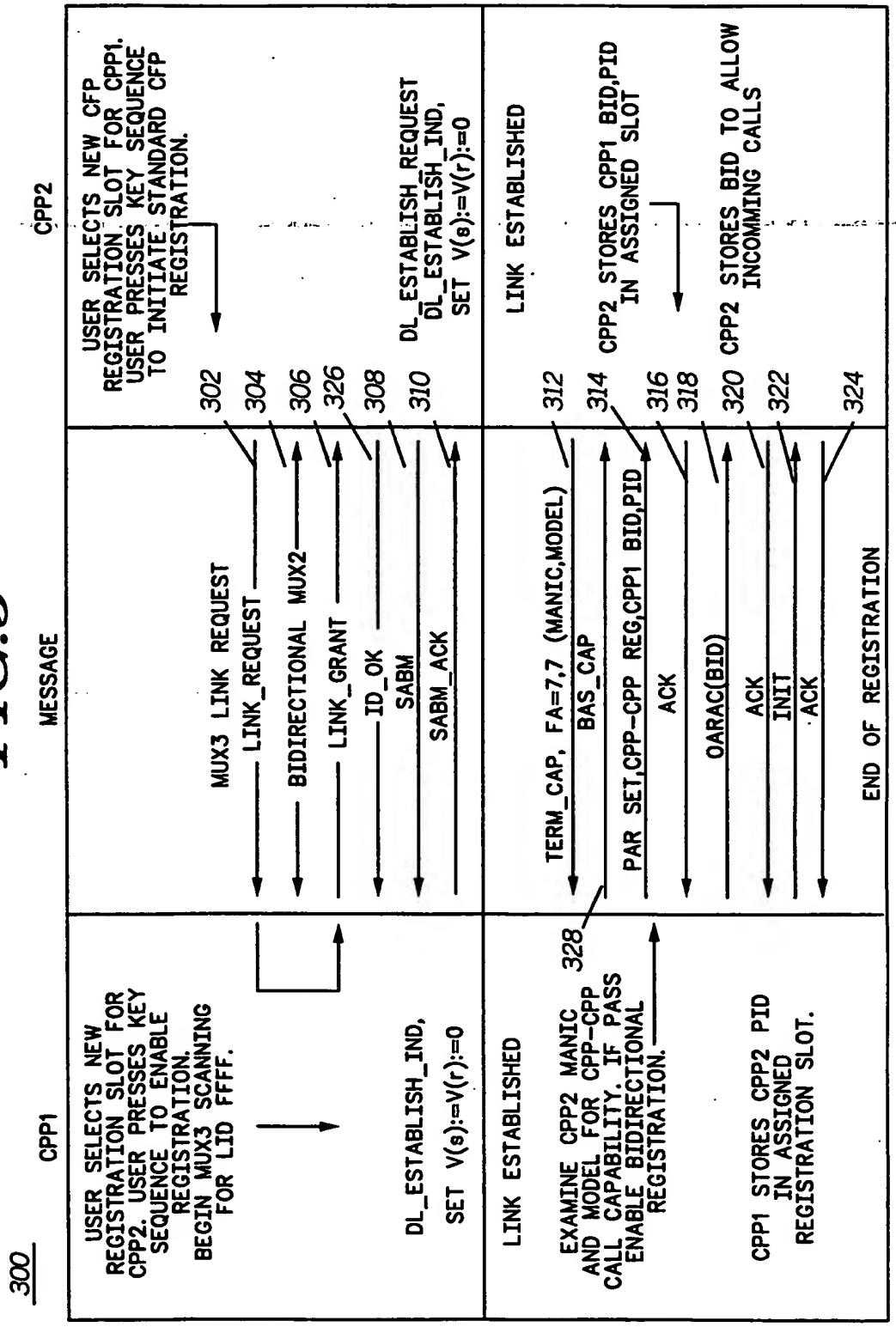

300
CPP1
MESSAGE
CPP2
USER SELECTS NEW REGISTRATION SLOT FOR CPP2. USER PRESSES KEY SEQUENCE TO ENABLE REGISTRATION. BEGIN MUX3 SCANNING FOR LID FFFF.
MUX3 LINK REQUEST
LINK_REQUEST
BIDIRECTIONAL MUX2
LINK_GRANT
ID_OK
SABM
SABM_ACK
DL_ESTABLISH_IND, SET V(s):=V(r):=0
USER SELECTS NEW CFP REGISTRATION SLOT FOR CPP1. USER PRESSES KEY SEQUENCE TO INITIATE STANDARD CFP REGISTRATION.
DL_ESTABLISH_REQUEST DL_ESTABLISH_IND, SET V(s):=V(r):=0
LINK ESTABLISHED
LINK ESTABLISHED
EXAMINE CPP2 MANIC AND MODEL FOR CPP-CPP CALL CAPABILITY. IF PASS ENABLE BIDIRECTIONAL REGISTRATION.
TERM_CAP, FA=7,7 (MANIC,MODEL)
BAS_CAP
PAR SET,CPP-CPP REG,CPP1 BID,PID
ACK
OARAC(BID)
ACK
INIT
ACK
CPP1 STORES CPP2 PID IN ASSIGNED REGISTRATION SLOT.
CPP2 STORES CPP1 BID,PID IN ASSIGNED SLOT
CPP2 STORES BID TO ALLOW INCOMMING CALLS
END OF REGISTRATION
302
304
306
326
308
310
312
314
316
318
320
322
324
328

FIG. 4

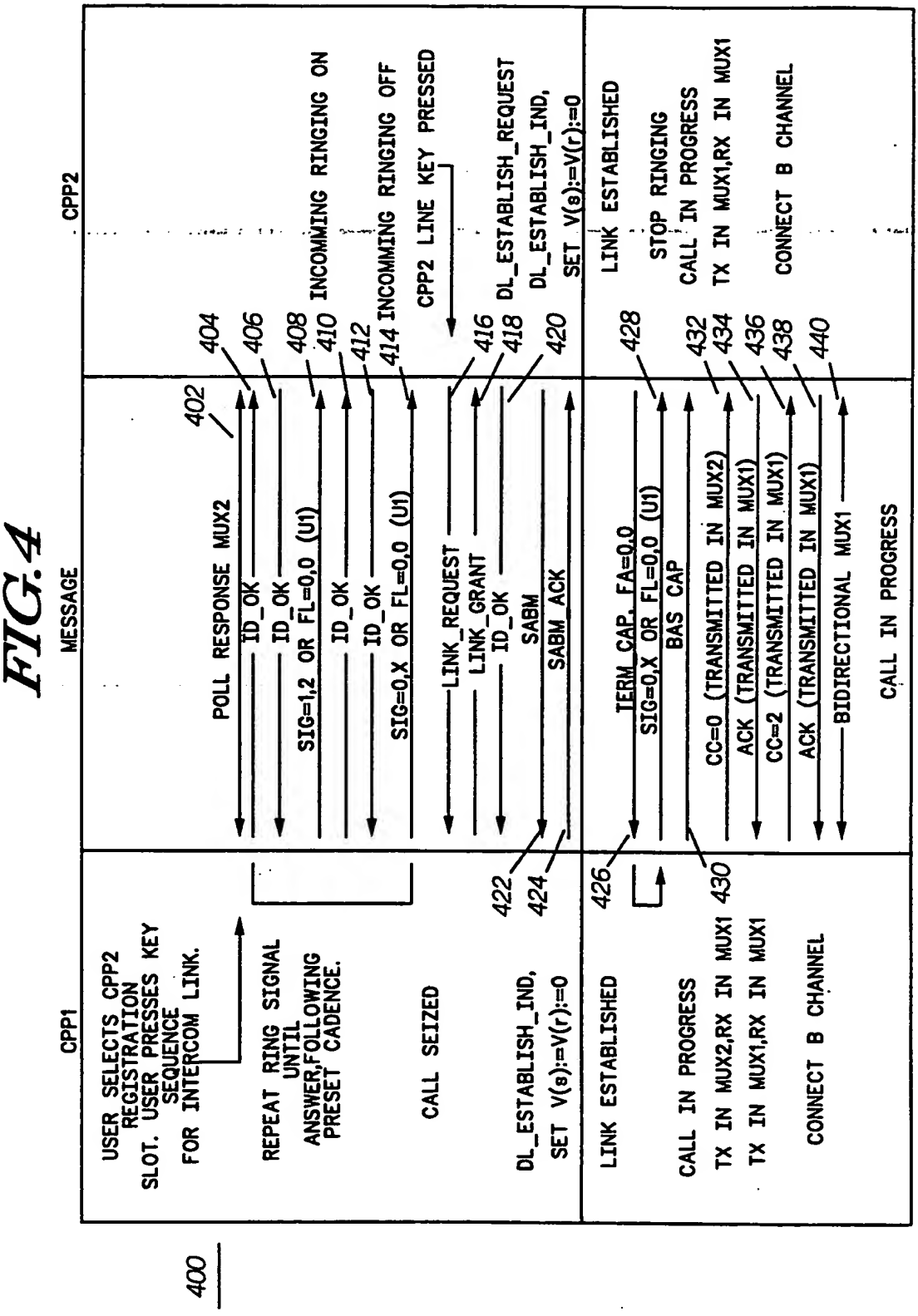
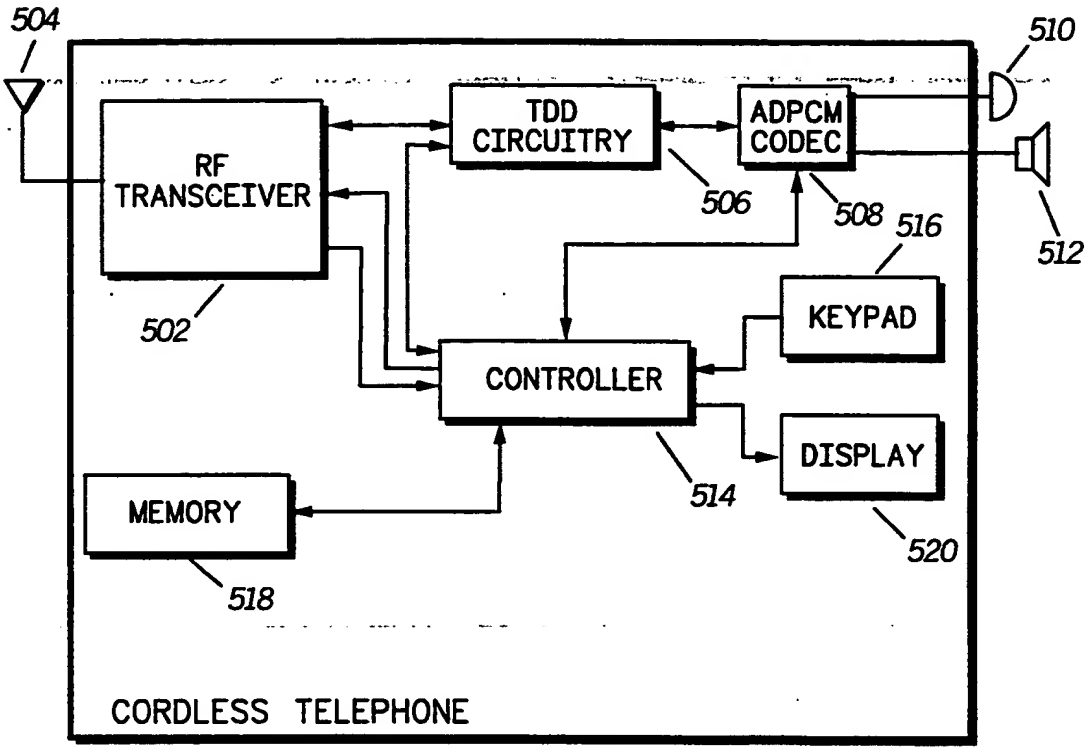

400
CPP1
MESSAGE
CPP2
USER SELECTS CPP2 REGISTRATION SLOT. USER PRESSES KEY SEQUENCE FOR INTERCOM LINK.
REPEAT RING SIGNAL UNTIL ANSWER, FOLLOWING PRESET CADENCE.
CALL SEIZED
DL_ESTABLISH_IND, SET V(s):=V(r):=0
LINK ESTABLISHED
CALL IN PROGRESS
TX IN MUX2,RX IN MUX1
TX IN MUX1,RX IN MUX1
CONNECT B CHANNEL
402
POLL RESPONSE MUX2
404
ID_OK
406
ID_OK
408
SIG=1,2 OR FL=0,0 (U1)
410
INCOMMING RINGING ON
ID_OK
412
ID_OK
414
INCOMMING RINGING OFF
SIG=0,X OR FL=0,0 (U1)
CPP2 LINE KEY PRESSED
LINK_REQUEST
416
LINK_GRANT
418
ID_OK
DL_ESTABLISH_REQUEST
420
SABM
DL_ESTABLISH_IND, SET V(s):=V(r):=0
SABM_ACK
422
424
426
IERM_CAP, FA=0,0
428
SIG=0,X OR FL=0,0 (U1)
STOP RINGING
BAS CAP
CALL IN PROGRESS
430
CC=0 (TRANSMITTED IN MUX2)
432
TX IN MUX1,RX IN MUX1
434
ACK (TRANSMITTED IN MUX1)
436
CC=2 (TRANSMITTED IN MUX1)
438
CONNECT B CHANNEL
ACK (TRANSMITTED IN MUX1)
440
BIDIRECTIONAL MUX1
CALL IN PROGRESS

FIG.5


504
510
TDD CIRCUITRY
ADPCM CODEC
RF TRANSCEIVER
506
508
516
512
502
KEYPAD
CONTROLLER
DISPLAY
514
MEMORY
520
518
CORDLESS TELEPHONE

500

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/07029

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(5) :H04B 17/00, 7/00; H04Q 7/00
US CL :455/33.1, 54.1, 56.1, 67.1, 89, 51.1; 379/59, 60, 61
According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/33.1,34.2, 51.2, 54.1, 54.2, 56.1, 67.1 89, 51.1; 375/113, 114; 379/59,60,61

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X<br>Y | US, A, 4,935,927 (Kaewell, Jr. et al) 19 June 1990. See entire reference. | 1-2<br>3-8 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

| | | | |
|---|---|---|---|
| * | Special categories of cited documents: | "T" | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| "A" | document defining the general state of the art which is not considered to be part of particular relevance | "X" | document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
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| "L" | document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "&" | document member of the same patent family |
| "O" | document referring to an oral disclosure, use, exhibition or other means | | |
| "P" | document published prior to the international filing date but later than the priority date claimed | | |

| | |
|---|---|
| Date of the actual completion of the international search<br>30 AUGUST 1993 | Date of mailing of the international search report<br>30 SEP 1993 |
| Name and mailing address of the ISA/US<br>Commissioner of Patents and Trademarks<br>Box PCT<br>Washington, D.C. 20231<br>Facsimile No. NOT APPLICABLE | Authorized officer<br>NGUYEN VO<br>Telephone No. (703) 305-4700 |

Form PCT/ISA/210 (second sheet)(July 1992)*